We claim:

1. A method of grinding a ferrous roll having a rotating roll surface with a rotating grinding wheel, the ferrous roll having a hardness greater than 65 SHC and a minimum diameter of at least 10 inches and a length of at least 2 feet, the method comprising:

a) mounting a grinding wheel on a machine spindle and setting the angle between the grinding wheel rotational axis and roll rotational axis less than about 25 degrees;

b) bringing the rotating wheel into contact with a rotating roll surface and traversing the wheel across an axial roll length, while maintaining a ratio of axial taper tolerance (TT) to radial wheel wear compensation (WWC) of greater than 10; and

c) grinding the roll surface to a surface roughness R_a of less than 5 micrometer while leaving the roll surface substantially free of feed marks, chatter marks, and surface irregularities.

2. The method of claim 1, wherein the roll is ground to a surface roughness R_a of less than 3 micrometer.

3. The method of claim 1, wherein the roll is ground to a surface roughness R_a of less than 1.25 micrometer.

4. The method of claim 1, wherein the ferrous roll surface is substantially free of thermal degradation of the roll material.

5. The method of claim1, wherein the ratio of TT to WWC is greater than 25.

6. The method of claim1, wherein the ratio of TT to WWC is greater than 50.

7. The method of claim 1, wherein the ferrous roll has a diameter of at least 18 inches and a length of at least 2 feet.

8. The method of claim 1, wherein said grinding wheel includes a layer comprising of a superabrasive material having a Knoop hardness greater than 3000 KHN, selected

from the group of natural diamond, synthetic diamond, cubic boron nitride, and mixtures thereof, with or without a secondary abrasive with Knoop hardness less than 3000 KHN, in a bond system.

9. The method of claim 8, wherein the superabrasive material is cubic boron nitride.

10. The method of claim 9, wherein the amount of cubic boron nitride in said grinding wheel bond system is in the range of 10 to 60 volume %.

11. The method of claim 9, wherein the amount of cubic boron nitride in said grinding wheel bond system is in the range of 20 to 50 volume %.

12. The method claim 8, wherein the bond system is one of: a) a vitrified bond comprising at least one of clay, feldspar, lime, borax, soda, glass frit, fritted materials and combinations thereof; and b) a resin bond system comprising at least one of a phenolic resin, epoxy resin, polyimide resin, and mixtures thereof.

13. The method of claim 1, wherein the grinding wheel is rotated from 3600 to 12000 fpm.

14. The method of claim 1, wherein said method further comprises the step of removing stock off the ferrous roll in one pass or multiple passes.

15. The method of claim 1, wherein material from the roll is removed at a rate greater than 2 cc/min.

16. The method of claim 1, wherein material from the roll is removed at a rate greater than 20 cc/min.

17. The method of claim 1, wherein material from the roll is removed at a rate greater than 35 cc/min

18. The method of claim 1, wherein the grinding is carried out at a G ratio of at least 20.

19. The method of claim 1, wherein the grinding wheel has an axis of rotation that is substantially parallel to the rotational axis of the roll.

20. The method of claim 1, wherein said ferrous roll is a solid revolution having a surface geometry selected from one of: a convex crown, a concave crown, a continuous numerical profile, and a polynomial shape along the axis of the roll, ground to a form profile tolerance of less than 0.05 mm.

21. The method of claim 1, wherein said grinding wheel has a traverse rate of at least 50 mm/min.

22. The method of claim 1, wherein said grinding wheel removes a stock grind amount of less than about 0.2 mm from the minimum worn roll diameter.

23. The method of claim 1, wherein said grinding wheel removes a stock grind amount of less than about 0.1 mm from the minimum worn roll diameter.

24. The method of claim 1, wherein said grinding wheel removes a stock grind amount of less than about 0.05 mm from the minimum worn roll diameter.

25. The method of claim 1, wherein said grinding wheel removes a stock grind amount of less than about 0.025 mm from the minimum worn roll diameter.

26. The method of claim 1, wherein said grinding wheel achieves the grinding of the ferrous roll with or without a profile or taper error correction pass.

27. A method of grinding a ferrous roll having a rotating roll surface with a rotating grinding wheel, the method comprising:

a) mounting the grinding wheel on a machine spindle;

b) bringing the rotating wheel into contact with the rotating roll surface and traversing the wheel across an axial roll length; and

c) grinding the roll surface while maintaining at least one or both of said grinding wheel rotational speed and said mill roll rotational speed varied in an amount of +/- 1 to 40% in amplitude, with a period of 1 to 30 seconds.

28. The method of claim 27, wherein said wheel rotational frequency (rpm) is varied at an amplitude of +/- 20% with a period of less than 5 seconds.

29. The method of claim 27, wherein the roll is ground to a surface roughness R_a of less than 3 micrometer.

30. The method of claim 27, wherein the roll surface is substantially free of thermal degradation of the roll material.

31. The method of claim27, wherein the ratio of TT to WWC is greater than 25.

32. The method of claim 27, wherein the roll has a diameter of at least 18 inches and a length of at least 2 feet.

33. The method of claim 27, wherein said grinding wheel includes a layer comprising of a superabrasive material having a Knoop hardness greater than 3000 KHN, selected from the group of natural diamond, synthetic diamond, cubic boron nitride, and mixtures thereof, with or without a secondary abrasive with Knoop hardness less than 3000 KHN, in a bond system.

34. The method of claim 33, wherein the superabrasive material is cubic boron nitride.

35. The method of claim 34, wherein the amount of cubic boron nitride in said grinding wheel bond system is in the range of 10 to 60 volume %.

36. The method claim 33, wherein the bond system is one of: a) a vitrified bond comprising at least one of clay, feldspar, lime, borax, soda, glass frit, fritted materials and combinations thereof; and b) a resin bond system comprising at least one of a phenolic resin, epoxy resin, polyimide resin, and mixtures thereof.

37. The method of claim 27, wherein the grinding wheel is rotated from 3600 to 12000 fpm.

38. The method of claim 27, wherein the grinding is carried out at a G ratio of at least 20.

39. The method of claim 27, wherein the grinding wheel has an axis of rotation that is substantially parallel to the rotational axis of the roll.

40. The method of claim 27, wherein said grinding wheel removes a stock grind amount of less than about 0.2 mm from the minimum worn roll diameter.